April 4, 1961 G. R. GEHRKENS ET AL 2,977,853

WEAPON DELIVERY METHOD AND MEANS

Filed Dec. 1, 1955 3 Sheets-Sheet 1

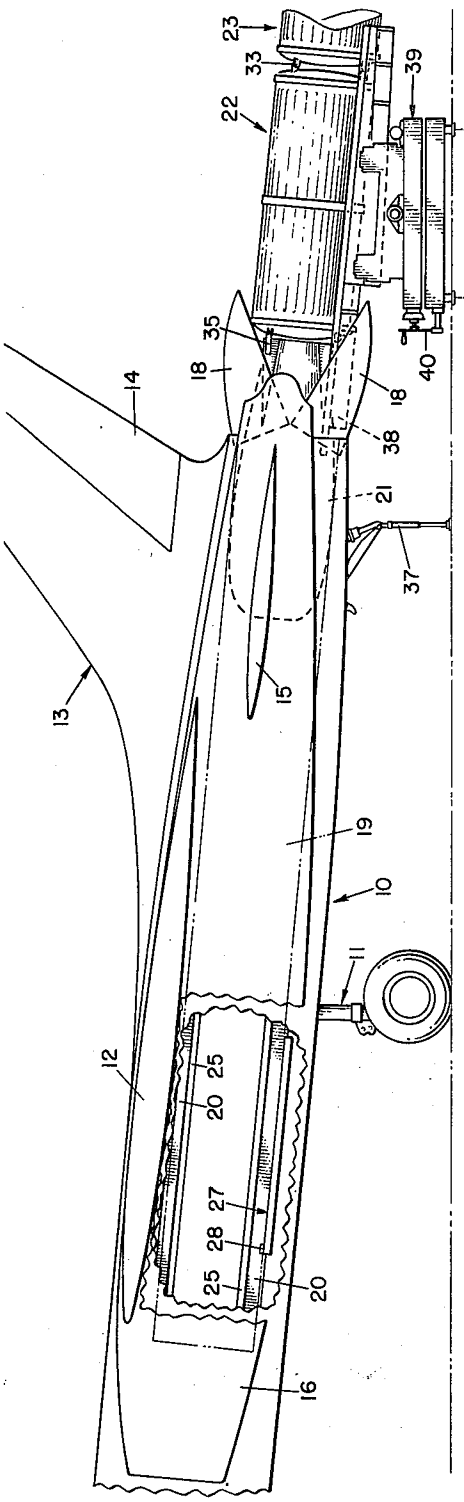

FIG. 1

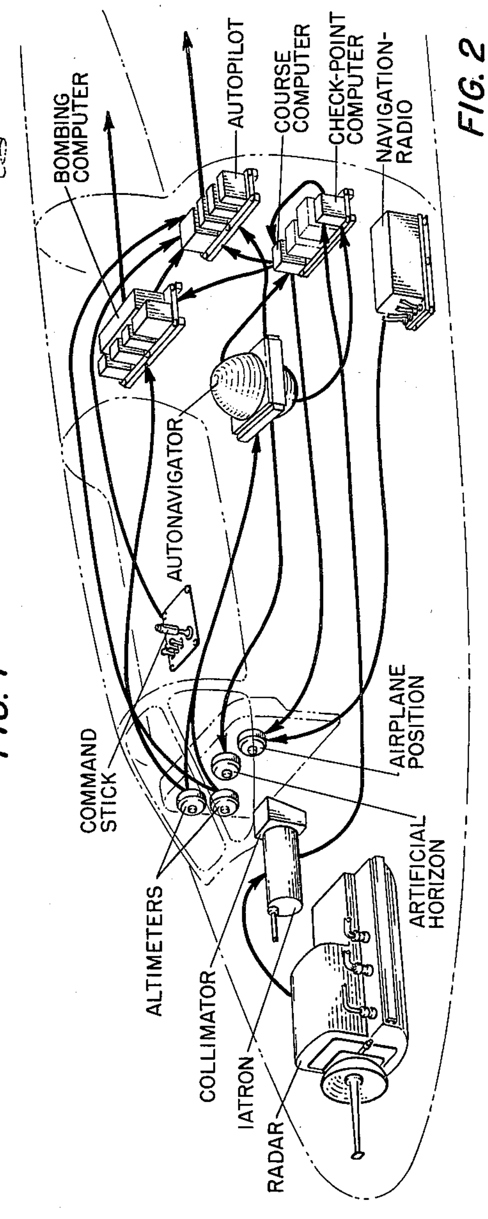

FIG. 2

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WEAPON DELIVERY METHOD AND MEANS

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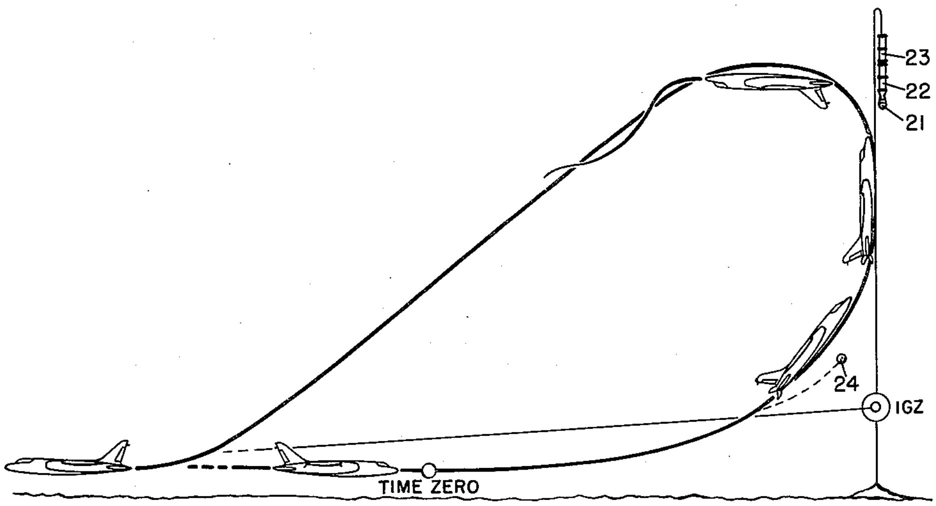

FIG. 3

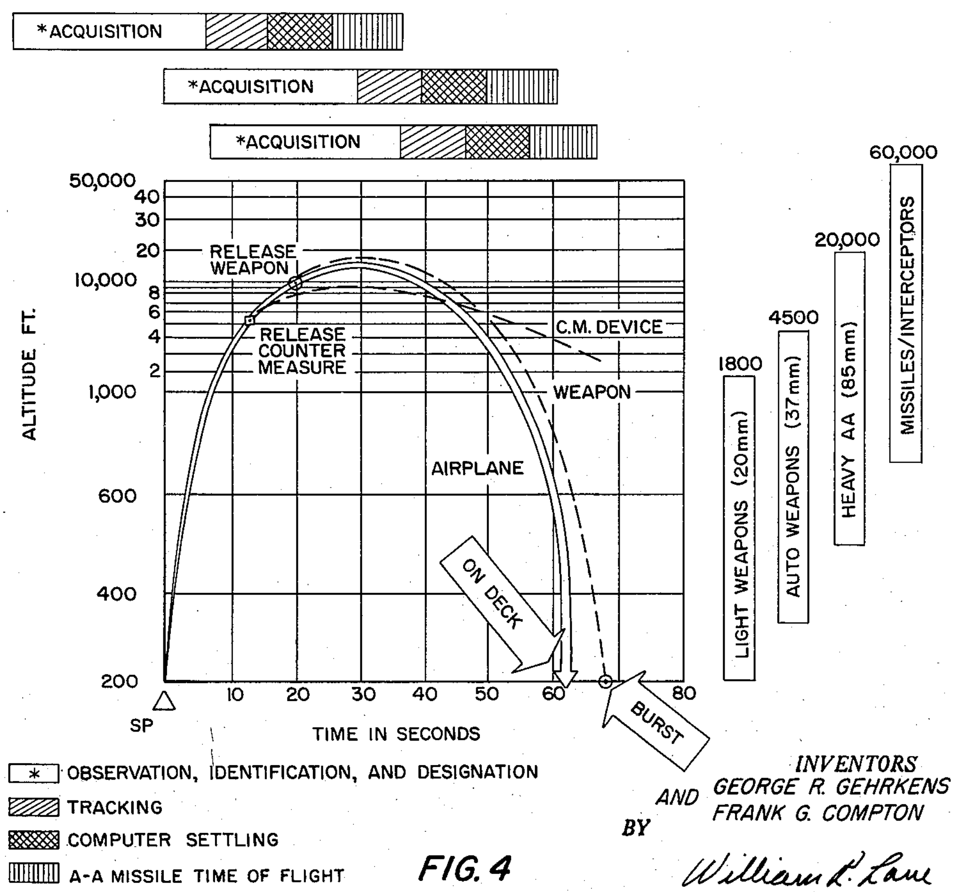

FIG. 4

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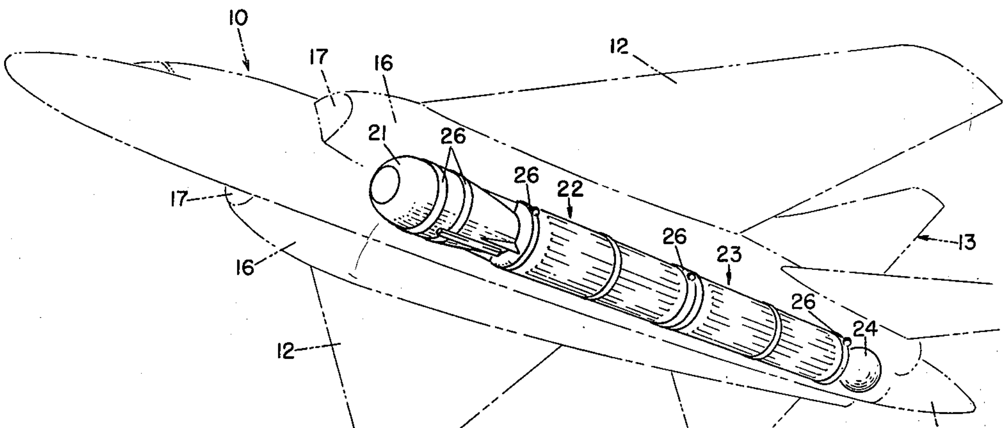

FIG. 5

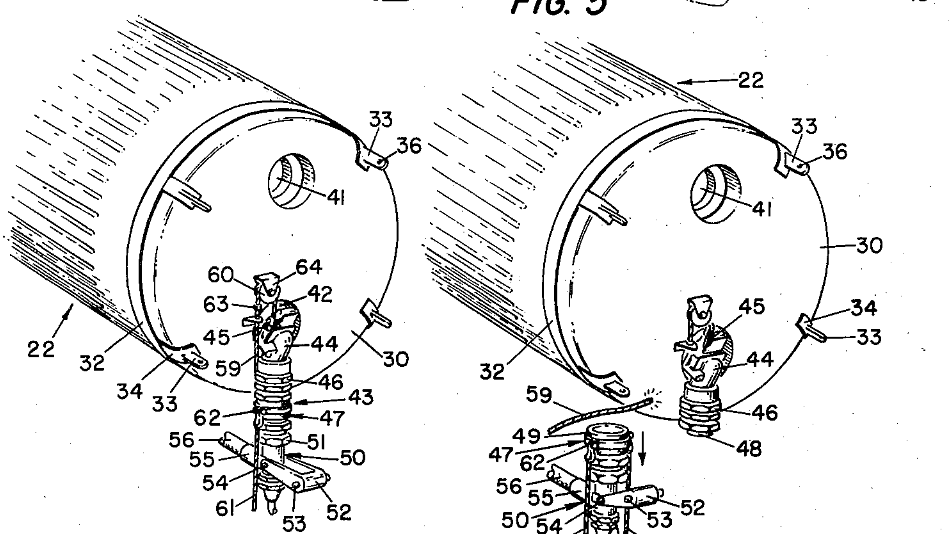

FIG. 6

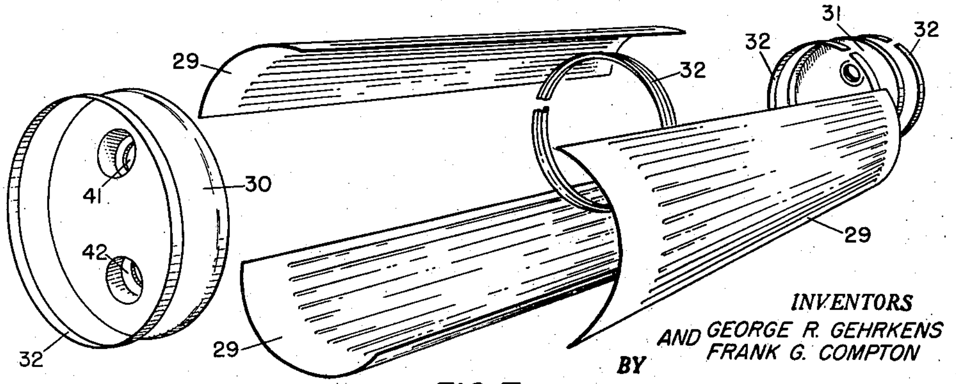

FIG. 7

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WEAPON DELIVERY METHOD AND MEANS

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3 Claims. (Cl. 89—1.5)

The present invention relates broadly to the art of aerial bombing, and is more particularly concerned with a new and improved method and means for carrying and dropping stores upon enemy targets.

It has become conventional practice in the art to carry stores or weapons on combat aircraft either internally in a bomb bay, externally under the wings, or in many cases, in both locations. And although a degree of drag is introduced when stores are mounted externally, the advantages gained by so locating the relatively smaller general purpose weapons have to a measure compensated for the drag factor for such missions as close support, interdiction, and general strike action.

With special stores, however, the conventional bomb bay or internal storage method is by far the most effective and practical. Nevertheless, utilization of such a bay having internally retractable bomb bay doors located substantially centrally of the fuselage has certain disadvantages. Thus, among other things, there is required elaborate sway bracing and suspension systems, fall clearance space, internally retractable doors and a close-out platform, each of which contributes measurably to an increase in airplane size and weight. Further, with the ever increasing use of airplanes traveling at supersonic speeds, and frequently being required to release the internally stored weapon at critical attitudes, there arises the problem of guaranteed weapon separation. In addition, it has been difficult in the release of special stores from conventional bomb bays to avoid imparting an undesirable very high initial load on the weapon with the relatively short ejection stroke permitted.

It is accordingly a primary aim of the present invention to provide a novel weapons system concept productive of a substantial decrease in airplane size and weight through the elimination of conventional means for supporting and releasing internally stored weapons.

Another object of the invention lies in the provision of a new and improved airplane having a substantially improved fuselage density ratio, accomplished through the utilization of relatively light weight containers attached to the weapon which function as fuel supply means for the airplane during its travel toward the target, and also as stabilizing means for the weapon upon ejection from the airplane, said arrangement allowing the performance of missions with airplanes of substantially decreased size and weight.

Another object of this invention is to provide a novel method of delivering an aerial borne weapon, which includes arranging a weapon and one or more attached fuel containing members within a bomb bay extending longitudinally throughout a substantial portion of the airplane fuselage, transporting said weapon and containers toward a target and during said movement supplying fuel to the airplane from the containers, and dropping the weapon and substantially empty containers from an opening at the rearward portion of the fuselage, said containers functioning to stabilize the weapon during descent toward the target.

Still another object of the invention lies in the provision of a new and improved weapon delivery means in combination with an aircraft fuselage having a normally closed opening at the aft end thereof, said means including a bomb bay extending longitudinally throughout a substantial portion of the fuselage, a weapon and attached fuel containers arranged within said bomb bay, and means for forcibly causing said weapon and attached fuel containers to move rearwardly through the bomb bay and outwardly from the opening at the aft end of the fuselage.

A further object of the present invention is to provide a novel method of delivering stores to a target, which comprises approaching the target along a line generally parallel to the earth's surface until the airplane substantially reaches a vertical line extending through the target, directing the airplane upwardly along a tangent generally parallel to said vertical line, and during said vertical upward movement, ejecting the weapon rearwardly from said airplane and toward said target.

Other objects and advantages of the invention will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

Figure 1 is a fragmentary side elevational view of the airplane and illustrating its linear bomb bay, as well as a preferred method of loading the weapon and fuel containers therein;

Figure 2 is a perspective view of a flight intelligence system which may be employed;

Figure 3 is a side elevational view showing a preferred store delivery method from the airplane's arrival at the solution point, through vertical ascent and weapon release, and return to the deck;

Figure 4 is a chart setting forth the altitude and time plot for the disclosed vertical release mode, as well as the effectiveness of typical weapon and ground-to-air missile systems;

Figure 5 is a perspective view of the airplane, and showing in full line the weapon, fuel containers and countermeasure device as normally located therein;

Figure 6 is a perspective view of one end of the fuel containers and illustrating the connecting coupling during fuel transfer to the airplane, and operation of the breakaway fitting just prior to ejection of the attached weapon and containers; and

Figure 7 is an exloded perspective view of the fuel container.

With reference now to the drawings, and more particularly to Figs. 1 and 5 thereof, there is provided an airplane comprising essentially a fuselage **10** supported upon a landing gear assembly **11**, and additionally including a wing **12**, tail **13** provided with vertical and horizontal stabilizers **14** and **15**, and engine nacelles **16** faired into the fuselage and enclosing the inlet ducts **17** to a pair of jet power plants (not shown). Arranged at the aft end of the fuselage are a pair of generally clam-shaped bomb bay doors **18** functioning to normally close a linear bomb bay or armament tunnel **19** provided in the substantially circular area between the four spaced longérons **20** which make up the basic fuselage structure. Carried within said linear bomb bay is an arrangement designed for the special weapons assignment, and this may comprise the weapon **21** having attached thereto one or more fuel containers **22** and **23**, and if desired, to the aft fuel can **23** a countermeasure device **24** may be releasably affixed.

Each of the bomb bay doors **18** are of substantially identical construction, and preferably are generally clam-shaped. The doors may be attached by suitable brackets to frame members carried by the fuselage, and linkages may be employed in connection with actuating means controlled in the cockpit to cause the doors to move upon fixed pivots during opening and closing. The specific means employed to support, latch and actuate the doors in unison do not form an integral part of the present disclosure, and are accordingly not herein shown or described in detail.

As an alternative arrangement to the clam shell doors disclosed, the aft fuel can 23 may be arranged in substantial sealing relation to the opening at the aft end of the fuselage. Suitable fairings or other means may be employed between said aft end and the outermost end of the fuel can, and said fairings may be forcibly ejected immediately prior to discharge of the weapon and attached fuel cans.

Each of the longérons 20 are provided on their inner marginal edges with caps 25 which function as guide rails during loading or ejection of the store or weapon 21, the longérons and caps thereon presenting a construction generally T-shaped in cross-section. For the purpose of adequately supporting the weapon 21 and associated fuel containers 22 and 23, there is provided at spaced locations in the linear bomb bay suitable sway bracing arranged to make rolling or other desired contact with the weapon and fuel cans. And to further brace the store while located in the armament tunnel, it is preferred to provide cushioning means in the form of plastic bands or the like 26 which closely encircle said store at locations spaced longitudinally thereof.

It is generally preferred that a continuous ejection force be employed for the purpose of rapidly causing the weapon to move rearwardly through the bomb bay 19 and outwardly between the open tunnel doors 18. Although a solid or liquid propellant rocket, or cartridge charge is effective to this end, it is preferred to employ small catapult means. One such means is generally shown in Figs. 1 and 5, and consists essentially of a generally cylindrically shaped catapult gun 27 located between the lower longérons and having one or more lugs 28 adapted to be received in suitable recesses in the weapon case and operative when energized by the fire control system, or fired by the pilot during a special release mode, to forcibly eject the store rearwardly. In addition, as a precautionary measure, a suitable mechanical actuator (not shown) may be provided to permit a crew member to manually release the weapon 22 and fuel cans 23 and 24 associated therewith.

As was earlier noted, the employment of the herein disclosed linear bomb bay and the location of fuel containers therein has among its advantages a highly dense fuselage arrangement and a substantial resulting reduction in airplane size and weight. As for example, by supporting the weapon and attached fuel cans upon the four main fuselage longérons, and utilizing said cans when empty to stabilize the ballistic shape, the space normally required for the weapon tail cone and stabilizing fins may be used for fuel. It is thus possible to utilize the short shape type of weapon. Further, by such an arrangement, it is estimated that up to 150 cubic feet of space may be saved by eliminating the use of elaborate sway bracing and suspension systems, fall clearance space, internally retractable bomb bay doors, and close-out platform.

With reference to Fig. 7 and the construction of the fuel containers, each is designed to be expendable, nestable when disassembled, and in order to adequately supplement existing fuel supplies, to carry a quantity of fuel preferably around 275 gallons. For this purpose each can is desirably fabricated from aluminum or the like, and comprises at least three side panels 29, which when assembled, circumferentially engage along their marginal end portions a pair of bulkheads 30 and 31, and are secured thereon adjacent their ends and substantially midway thereof by a plurality of locking rubbing strips or hat rings 32. When the containers are to be employed as fuel carriers, a bladder type cell of conventional fuel resistant construction will of course be

arranged interiorly of the container. In addition, the side panels 29 may be provided with a plurality of lateral corrugations to permit flexure of the containers with the aircraft fuselage during the imposition of high "G" loads thereon.

It may at times be desired to utilize the cans for purposes other than to carry fuel during a special store mission, as for example and without limitation, to house a quantity of passive countermeasure devices, elements of rescue gear, or a load of such weapons as that known in the art as "Lazy Dogs." In addition, one or more of the tanks may be used for "Napalm," to carry hydrogen peroxide as a propellant should it be desired to utilize a rocket engine to provide the airplane with superior combat performance at high altitudes, and for the accomplishment of missions such as close support, interdiction and general strike action, the special weapon attached at the forward end of the fuel cans may be replaced with an additional fuel can, and thereby greater striking distance given to the airplane. And the latter arrangement of three fuel cans may find additional effectiveness should it be desired to use the airplane as a tanker for refueling purposes.

For the special weapon delivery mission, however, the arrangement of Figs. 1 and 5 is particularly effective. In order to connect the fuel cans 22 and 23 one to another and attach the weapon 21 to the forward portion of the fuel container 22, there is provided at opposite ends of said container 22 a plurality of lugs 33 spaced around the circumference of the container and having a flange portion 34 receivable between the rubbing strip 32 and bulkhead 30 or 31, or integrally secured to said bulkhead by welding or other means. At the forward portion of the fuel can 22, the lugs 33 thereon are adapted to be received between the ears of bifurcated members 35 spaced upon the circumference and set within the aft end of the weapon 21. Suitable pins or other means passing through openings in the lugs 33 and bifurcated members may be used to securely attach the weapon to the forward fuel container 22. And to affix the forward portion of the aft fuel can 23 to the aft portion of the forward container 22, the lugs 33 on each container may be located in aligned relation and locking pins or other suitable devices passed through the openings 36 in said lugs to thereby secure the containers one to another.

Loading of the weapon 21 and fuel containers 22 and 23, or fuel cans alone if a special store is not to be carried on the mission selected, may be accomplished by first locating a loading jack 37 of the character shown in Fig. 1 under the aft portion of the airplane fuselage 10 to support and raise said portion to the desired level. The weapon, and subsequently the fuel containers, may be transported to the site of loading by a torpedo truck or other suitable device and thereafter located upon a pair of spaced loading rails 38 suitably attached inwardly of their rearward ends to a ship's positioner 39, and secured at their opposite ends to the longérons 20 which function as guide rails during movement of the weapon or fuel containers in the linear bomb bay 19. As is known, the ship's positioner is generally a standard piece of equipment on aircraft carriers for elevating internally carried weapons to a position of attachment within the airplane, and accordingly is provided at opposite ends with crank means 40 to raise or lower either of said ends as desired. However, as will be appreciated, other positioning means, such as a suitable hoist device, may be employed.

After location of the weapon 21 upon the loading rails 38, a pulley or similar means (not shown) may be attached to said weapon, and by means of a winch connected thereto, the weapon caused to move generally into the position shown in Fig. 1. The forward fuel can 22 is then located upon the loading rails 38 supported on the ship's positioner 39, and the weapon connected to the forward fuel can be passing suitable lock pin means through the lugs 33 on said can and bifurcated members provided on the aft end of the modified weapon. Thereafter the weapon and attached fuel can are pulled forwardly into the linear bomb bay 19 by action of the winch means, the aft fuel can positioned on the loading rails, and the opposite ends of said fuel cans 22 and 23 locked or otherwise secured together by means of the lugs 33.

The entire assembly as thus formed may be drawn completely into the armament tunnel or linear bomb bay, by means of a winch or similar device, until the weapon is substantially completely forward in the bay. At that time, through suitable fuselage access doors of the type known to the art, such operations may be performed as connecting the catapult gun 27 to the weapon, adjusting suitable sway bracing into contact with the weapon and fuel cans, attaching the countermeasure device 24 to the aft fuel can, connecting the fuel lines to the containers, as will now be described, and such other steps obvious to one skilled in the art.

With regard to the step of connecting the fuel lines within the airplane to the fuel containers 22 and 23, this may be readily accomplished also through access doors in the lower portion of the fuselage 10 as said cans are moved into the linear bomb bay 19 and after reaching their final location therein. Thus, as appears in Fig. 6, there is provided in each fuel can bulkhead 30 or 31 two spaced openings 41 and 42, one at the upper and the other at the lower portion thereof, said openings being adapted to receive either a disconnect means 43 as is illustrated, a closure cap, or piping (not shown) which passes between the connected fuel cans and serves to transfer fuel therebetween.

To explain further, when said fuel containers are arranged in end to end relation, and preferably prior to being moved into the airplane as above described, the two openings 41 and 42 at the rearward end of the aft fuel can 23 may be sealed with a suitable cap device and a similar device used to seal the upper opening 41 at the forward end of said can. Thereupon a length of hose or pipe of suitable size and configuration may be passed from within the forward fuel can 22 and adjacent the inner upper portion thereof, through the opening 42 in the rearward end of said can and into a similar opening at the forward end of the aft fuel can 23 and along the bottom of the inside thereof. By such an arrangement the aft fuel container will be filled during fueling after the capacity of the forward tank 22 is reached, and thus if desired for a particular purpose, only the latter container need be filled.

With the connections made as thus set forth, and as the attached fuel cans are moved into the linear bomb bay 19, the cans are directed as they approach their final position in a manner whereby the opening 42 on the forward fuel can 22 will be aligned with the disconnect means 43 of Fig. 6 normally located in the lower portion of the forward end of the linear bomb bay. Attachment may then be accomplished between said disconnect means and a suitable fitting carried in the opening 42, and associated with a substantially rigid length of hose arranged adjacent the inner bottom wall of the container 22. As noted earlier, said attachment may be readily effected through conveniently located fuselage access doors.

The disconnect means 43 is constructed to provide a relatively simple and reliable arrangement to speedily sever the connection between the fuel containers and the main airplane fuel supply system, immediately prior to ejection of the weapon and attached fuel cans, and at the same time, to assure that any fuel in the lines to said system and adjacent the disconnect means 43 will be substantially entirely purged therefrom. The disconnect means accordingly comprises, as shown in Fig. 6, a gate valve 44 attached to the forward fuel can 22 by means of a suitable fitting carried in the opening 42 of said can, the gate valve being provided with a spring loaded lever 45 normally maintaining said valve in an open position. Arranged beneath the gate valve 44 and connected thereto by threaded sleeve members 46 is a self-sealing quick disconnect fitting 47 formed of a male member 48 and female member 49. Threadably joining the female portion of said fitting to one arm of a generally T-shaped connector 50 are additional sleeve members 51.

The connector 50 is pivotally supported on aircraft structure by means of a substantially U-shaped member 52, said member being provided adjacent its bottom portion with pins 53 receivable in said structure and additional pins 54 passing through the top portion of said member and about which the T-shaped connector 50 is adapted to pivot. Extending outwardly from the leg 55 of said connector is the fuel transfer line 56 leading to the main fuel supply system, and attached to the other arm of the connector 50, by threaded sleeve members 57 or the like, is a tube or hose 58 terminating in a pneumatic cylinder of suitable construction (not shown).

The pneumatic cylinder may be adapted to include a piston at the outer end of which a cable 59 is attached, said cable being guided over a pulley 60 mounted on the fuel container bulkhead 30 and tied or otherwise secured at its opposite end to the lever 45 of the gate valve 44. Upon said piston there may also be carried a pair of lower cables 61 which terminate at their opposite ends in attaching rings 62 secured to the female member 49 of the breakaway fitting 47.

Operation of the disconnect means 43 is substantially as follows. At a predetermined time prior to release of the weapon 21 and attached fuel containers 22 and 23 from the linear bomb bay 19, a switch in the cockpit is thrown energizing an air solenoid valve causing air flow to the pneumatic cylinder. As the piston on said cylinder begins its downward travel, the cable 59 is caused to move over the pulley 60, and by means of the lever 45 on the gate valve 44, said valve is closed and a positive shut-off of fuel is provided. Continued travel of the cylinder piston will cause further movement of the cable 59 until the cable connector 63 is forcibly drawn against the bracket 64 carried by the fuel can bulkhead 30, and thereby said cable separated and disconnected at the fuel container. Subsequently, at generally the mid-point of the piston travel, high pressure air is caused to flow into the pneumatic cylinder and through the tube or hose 58, to thereby urge the closed fuel line. Thereafter, by means of additional piston travel, the pair of cables 61 are pulled to positively separate the male and female members 48 and 49, respectively, of the breakaway fitting 47, followed by final travel of the piston and displacement of the disconnected fuel line from the path of the weapon, substantially as shown in Fig. 6.

It may thus be seen that there is provided a spillage-proof, automatic quick-disconnect of the fuel line from the containers, accomplished in part by the positive shut off at the manual gate valve and high pressure purging of the disconnected portion of the fuel line immediately prior to the actual disconnect. Positive manual action is employed to assure speedy and reliable operation, and a manual release lever may be provided in the cockpit connected to the cylinder piston to permit the disconnect to be readily accomplished in the event of an electrical failure.

The herein disclosed airplane, embodying the novel linear bomb bay housing a weapon and attached fuel containers, is designed to effectively deliver the composite package from any altitude or at any attitude within the design limits of the airplane. And this may be accomplished by either one of several bombing modes, namely, the vertical or high angle ascent drop, the low angle toss, the over-the-shoulder toss, dive release and lob.

To illustrate the possible vulnerability of the high angle or vertical release mode to known weapons and ground to air missile systems, there is plotted in Fig. 4 in terms of altitude versus time the path of the airplane from the instant of reaching the bombing solution point (SP), through the release of the countermeasure device and weapon, and to the return of the airplane to the deck, showing the time difference between deck return and weapon burst. Located above the main graph and scaled to the time coordinate thereof are three bars representing a like number of typical ground to air missile systems, said bars being marked to show the typical time span normally required for the operations of aquisition, tracking, computer settling, and missile time of flight. Arranged to the right of the main graph, and in this case scaled to the altitude coordinate of said graph, are four additional bars showing the normal ranges of defense actions which it may be anticipated would be employed against airplanes of the type herein disclosed.

While reference will be made hereinafter to the preferred altitudes and time intervals to be used in the vertical or high angle ascent drop, it may be seen from the main graph of Fig. 4 that in a typical bombing run the countermeasure device will be released at approximately 12.3 seconds after initiation of the pull-up begun at time zero, said release being made at about 5000 feet. Further, it is shown that at about 9660 feet and 18.3 seconds after pull-up the weapon is released, after which a programmed roll out just past the crest of the loop will be made by the pilot. The pilot will then dive the airplane toward the deck, and will be then protected largely against defense activity at about 62 seconds after pull-up, and the weapon burst will occur around 6 seconds thereafter.

Referring now to the three bars over the main graph, and which are representative of three A-A missile batteries, it may be seen from the uppermost bar that battery 1 acquires the airplane at approximately 25 seconds prior to pull-up, in the center of impact annulus, which represents an improbable solution. Battery 2, shown by the middle bar, acquires the airplane at substantially the instant of pull-up, which constitutes what may be considered a probable solution. Battery 3, on the other hand, acquires the airplane, as indicated by the lower bar, at about 6 seconds after pull-up and at approximately 1000 feet altitude. This would appear to be the most probable solution.

Nevertheless, even in the event the airplane was tracked during a run-in at increased altitude, and the missile fired during the pull-up while the airplane was maneuvering rapidly and changing altitude and direction rapidly, the likelihood of a hit being made is greatly reduced. And even in an ideal situation where the airplane is acquired, tracked and a missile launched under favorable conditions, the airplane still retains an advantage in at least the ratio of 0.8 to 0.5 of survival. It may thus be seen from the foregoing, as indicated in Fig. 4, that the novel vertical or high angle release mode of the present invention is characterized by adequate escape margins, and as earlier mentioned, has the further advantage of being more accurate than other high angle toss modes. In addition, as has also been pointed out, the arrangement of a weapon and attached fuel containers in a linear bomb bay provides a remarkably high fuselage density ratio.

In order to accurately deliver the weapon to the target by the vertical or high angle release mode or either of the other bombing modes mentioned above, it is also within the contemplation of this invention that there be provided an integrated weapons system including a non-radiating navigation-bombing device termed an inertial autonavigator, radar for check point acquisition and autonavigator calibration, an autopilot, command stick, and computer group. In such a system the autonavigator will provide guidance to close support on-station holding point, low altitude navigation and location of point target, and post strike orientation including a return to the carrier position or an alternate airport. The autopilot, on the other hand, is designed to control a precision flight path during automatic bomb release, as well as to provide full or partial control during cruise, during the escape, and while the pilot or navigator-bomber is identifying the check point or target. Further, the command stick may be employed for control during take-off, landing and any other manual mode, while the computer group is effective to translate command signals from navigation or bombing computers into control surface actuation, and when selected, automatic weapon release.

A typical flight intelligence system embodying the foregoing navigation, flight control, bombing and communication systems is portrayed in Fig. 2. It may thus be seen that there is provided a search and calibration radar which assists in locating a navigation point. For the pilot's display a high intensity CR tube source would be projected through a collimating optical system to a windshield display, said display also including autonavigator cursors, flight position indicator, and a gun-bomb-rocket sight reticle. Included also is a stabilized platform which supplies the course computer with latitude and longitude position and the autopilot with gimbal angles, there also being mounted on the stabilized platform distance meters which integrate accelerations to obtain displacement relative to predetermined coordinates.

As also appears, there is provided a course computer to correct for the earth's rotation, compounded position, earth's deviation from a true sphere, and latitude of the base point. A check point computer functions to calibrate the stable platform and distance meters through signals received from manual "pickling" over the check point or manual centering of the cursors during radar checking of said check point. A course computer is designed to furnish azimuth reference for controlling the lateral course of the airplane and supplies the pilot with ground speed and relative target position information. An autopilot computer, on the other hand, is provided to convert signals from the bombing computer, course computer and command stick to a usable signal for the control surface actuators by the use of information from the autonavigator, altimeters, rate gyros, and airframe accelerometers.

Further, in the flight intelligence system disclosed, a radar altimeter measures true altitude for low level approach and calibrates the barometric altimeter when the terrain level is known. Artificial horizon is served by the stabilized platform, to provide a fully maneuverable flight indicator presentation. And as is understood, there is also included suitable radio equipment to supply the requirements for communication, identification and navigation.

The operation of the integrated weapons system above described, in association with the airplane herein disclosed, can possibly best be appreciated by briefly outlining a typical tactical situation in which there is assumed a strike mission from a carrier 440 nautical miles offshore with the target 60 nautical miles inland.

Previous reconnaissance has provided information as to the characteristics of the terrain along the flight path to the target area, and in the situation visualized, there is pin-pointed a small harbor with a predominate steel pier located on the coastline 60 nautical miles from the target. The pier will be selected as the primary check point. In addition, photographic strip maps previously taken of the area, together with other intelligence information, have confirmed the maximum error existing between the primary check point and the target to be not more than 150 feet. For such a mission the present autonavigation and bombing system will normally have only approximately 760 feet navigation error, and added to the bombing error of 89 feet, a circular error of probability (C.E.P.) of 849 feet will generally result. Knowing this, the proper weapon core may be selected to accomplish the results desired.

At approximately 30 minutes prior to the take-off hour, the airplane will be fueled and checked, the pilot briefed, and the weapon loaded and made ready. In addition, the airplane inertial autonavigator will be precisely aligned and checked. The alignment may be accomplished optically by sighting with a portable autonavigator, which in turn is adapted to be maintained in alignment by a master autonavigator system suitably located on the carrier deck, or remotely aligned by electrical circuitry from the ship's autonavigator system.

On the autonavigator instrument panel provided in the cockpit, position information of various types is indicated. Such data prior to take-off preferably includes distance to the target, distance north and east of a base reference point, and alternate target setting or the carrier position for return flight. And during the flight, the autonavigator instrumentation indicates the exact position of the airplane relative to a pre-selected coordinate position, as well as ground speed, target range, course line, target line, and when selected, heading to an alternate target or carrier position.

Following take-off, the pilot will normally climb to cruise altitude, and while at said altitude, will select "Hold Mach Number" on the autopilot panel, continuing his cruise-out to the target. The autonavigator will make good a predetermined track and accurately guide the airplane toward the check point. As the check point is approached approximately 150 miles from the target, the let down to minimum run-in altitude is generally begun. The minimum altitude run-in preferably continues for approximately 100 miles, and has the important advantages of substantially preventing enemy radar acquisition and degradation by surprise, as well as to reduce the effectiveness of enemy countermeasure devices.

Just prior to reaching the minimum cruise-in altitude level, the search calibration radar is fired-up in preparation to searching the shore line system. And as the check point is approached, the search-calibration radar will penetrate the ground haze and indicate the shore line contour. Preferably, the radar presentation is PPI sector scan scope image reflected off the windshield glass from a high intensity cathode-ray tube with a fresnel collimator mounted behind the instrument panel, as shown in Fig. 2. This collimated presentation is particularly advantageous since it only requires minimum pilot-eye depth adjustment to observe the fast approaching objects, either by direct sight or by scope presentation, and further provides a definite safety factor for a flight condition combining high speed at minimum altitude. And in the case of a two-place version of the airplane, it would be desirable to provide the navigator-bomber with a relatively large conventional radar indicator unit.

In the typical tactical situation being portrayed, as the plane closes in on the check point area at approximately 15 miles, a harbor will be identified on the radar display, and thereafter the airplane promptly steered toward the center of said harbor. At approximately 5 miles out, the radar presentation may readily be expanded, and the horizontal and vertical cursors will indicate the expected position of the check point. Thereupon, the cursors may be manually adjusted to center on said check point, in order that the position error may be fed into the autonavigator.

If the check point is not physically visible at a distance of approximately ¾ of a nautical mile, the autonavigator may be calibrated by a corrected cursor position on the radar display. However, if it is desired to penetrate without radar radiating, the pilot may visually acquire said check point, and his lateral course corrected so that the airplane will fly directly over the check point. Then at the instance of passing over said check point, a button on the autopilot panel (Fig. 2) may be pickled to correct the autonavigator position error. The autonavigator is now calibrated and will steer automatically, or indicate for pilot direction, a corrected track to the target.

In addition, as the check point is passed, it is preferred that the radar be shut down in order to black out electronic radiation, and when approximately 42 miles from the target, the pilot will preferably advance the throttle to maximum power. Further, and normally a few minutes prior to reaching the bombing solution point indicated in Fig. 3, the internal expendable fuel tanks attached to the weapon will be shut off, and the valve units positively purged to avoid the possibility of fuel spillage during store release and the fuel coupling disconnection.

As the airplane moves closer to the target, a selector switch provided on the autonavigator panel will normally be moved from a position such as "Check Point 1" to "Bomb Target" and at substantially the same time, a mode selector also on said panel may be moved from a "Navigation" to "Vertical Drop" position. Continuing on automatic control toward the target, the airplane at time "0" will automatically begin a pull-up in the manner shown in Fig. 3, and, with reference now also to Fig. 4, at approximately 12.3 seconds after the initiation of said pull-up and at approximately 5,000 feet, the countermeasure device 24 will be released. Thereafter, preferably at about 9660 feet and 18.3 seconds after pull-up, the store will be ejected rearwardly out of the tunnel during a one-second period at zero "*g*" when the airplane is substantially tangent to a perpendicular through intended ground zero (IGZ).

Subsequent to the release just described, the autopilot is adapted to program an automatic escape maneuver to roll the airplane out just past the crest of the loop, and will hold the airplane on level flight until the pilot noses over toward the deck for protection against defense activity. As the airplane reaches the deck, a 50 nautical mile run-out will preferably be initiated. The mode selector may thereupon be switched to "Navigation" and the target selector to "Altenate" to provide, by means of suitable alternate setting indicators on the console panel, the location of the carrier at its estimated position. By means of a target indicator, the direction and distance to the estimated carrier position may be provided, and ground speed and present position relative to a predetermined base point made available to the pilot by an airplane position indicator. And to assist in terminal navigation and orientation as the airplane approaches the estimated task force position, there may be employed radar or an arrangement in which DME is coupled to the target indicator.

While the flight intelligence system herein disclosed has been described in connection with execution of a vertical ascent weapon release maneuver, it will be appreciated that said system is of important application with other release modes. Further, although it is preferred to employ an inertial autonavigator in the integrated weapons system, it is considered possible to successfully utilize a sensitive accelerometer and rate gyro information as a standby method in the event the bombing computer portion of the inertial autonavigation system should fail. In the standby arrangement the pilot would manually pull up, and hold vertical ascent while ejecting the weapon rearwardly.

It is to be understood that the forms of the invention herein shown and described are to be taken as the preferred embodiments of the same, and that various changes in the shape, size and arrangement of parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

We claim:

1. In combination with an airplane having a fuselage portion provided with an opening at the aft end thereof, an armament tunnel contained interiorly of said fuselage portion and extending longitudinally throughout a substantial portion thereof, a weapon and at least one filled fuel container attached thereto positioned within said armament tunnel, severable means for transferring fuel from each said fuel container to the power plant of said airplane, and ejector means for forcibly causing the weapon and fuel containers attached thereto to move rearwardly through said aramament tunnel and outwardly

from the opening provided at the aft end of said fuselage portion.

2. In combination with an airplane having a fuselage portion provided with an opening at the aft end thereof, a plurality of longitudinally extending fuselage structural members arranged in spaced relation and defining an armament tunnel within said airplane fuselage portion, a weapon and attached filled fuel container member supported by said longitudinally extending fuselage structural members, disconnectable fuel supply means operatively connecting each said fuel container member with the power plant of said airplane, and ejection means supported by the airplane fuselage portion and contacting said weapon, said ejection means being arranged to cause said weapon and attached fuel containers to move rearwardly along said fuselage structural members and outwardly from said airplane through the opening provided in the aft end thereof.

3. In combination with an airplane having a fuselage portion provided with an opening at the aft end thereof, at least four spaced fuselage longérons defining an armament tunnel which extends a substantial portion of the length of said airplane fuselage, a weapon supported by at least two of said spaced longérons and positioned forwardly within said armament tunnel, at least one generally cylindrical fuel container supported within said armament tunnel by at least two of said spaced longérons and attached to the aft end of said weapon, fuel transfer means provided with quick-disconnect components and

operatively connecting each said fuel container with the power plant of said airplane, and ejection means located adjacent said longérons and arranged in engagement with said weapon whereby said weapon and the fuel containers attached thereto may be forcibly moved rearward through said armament tunnel and outward through said fuselage aft end opening, at least two of said spaced longérons being arranged in supporting and guiding relation at one side of the weapon and fuel container assembly and at least two of said spaced longérons being arranged in supporting and guiding relation along the opposite side of said weapon and fuel container assembly.

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